A Prospective Study of

FUNCTIONAL OUTCOME OF CLOSED SUBTROCHANTERIC FRACTURES MANAGED BY VARIOUS SURGICAL METHODS

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Certificate of Approval

This is to certify that this dissertation in **"PROSPECTIVE STUDY OF FUNCTIONAL OUTCOME OF CLOSED SUBTROCHANTERIC FRACTURES MANAGED BY VARIOUS SURGICAL METHODS"** is a bonafide work done by **Dr. B. UGANATH SUBASH** under my guidance during the period June 2006 – November 2008. This has been submitted in partial fulfillment of the award of **M.S.** Degree in **Orthopaedic Surgery (Branch – II)** by the Tamilnadu Dr. M.G.R. Medical University, Chennai.

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DECLARATION

I, **Dr. B. UGANATH SUBASH,** solemnly declare that the dissertation titled "THE FUNCTIONAL OUTCOME OF CLOSED SUBTROCHANTERIC FRACTURES MANAGED BY VARIOUS SURGICAL METHODS" was done by me at The Government Royapettah Hospital, Chennai – 14, during 2006-2009 under the guidance of my unit chief **Prof. K. NAGAPPAN, M.S(Ortho), D. Ortho.**

The dissertation is submitted in partial fulfillment of requirement for the award of M.S. Degree (Branch – II) in Orthopaedic Surgery to **The Tamil Nadu Dr. M.G.R. Medical University.**

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CONTENTS

INTRODUCTION

Fractures of the femur are commonly encountered in Orthopaedic practice. Of all femur fractures, 7% - 34% occur in the subtrochanteric region[1].

Subtrochanteric femur fractures have demanded special consideration in Orthopaedic Traumatology, given the higher rate of complications associated with their management.

The intense concentration of deforming forces and decreased vascularity of the region have challenged orthopaedicians with problems of malunion, delayed union, nonunion and implant failure.

Recently, better understanding of fracture biology, reduction techniques, image intensification and biomechanically improved implants allow for subtrochanteric fractures to be addressed with consistent success.

AIM OF THE STUDY

- To evaluate the functional outcome of closed Subtrochanteric fractures managed surgically at Government Royapettah Hospital/Kilpauk Medical College, Chennai from June 2006 to November 2008.

SURGICAL ANATOMY

The subtrochanteric region is described as the area extending below inferior border of lesser trochanter to the junction of the proximal and middle one third of the femur approximately about 7.5cm[1, 2, 3].

The transition between the cancellous bone of the intertrochanteric region to thick cortical bone in the diaphysis makes the subtrochanteric area, the most attenuated area of cortical bone with the narrowest cortical wall thickness.

The greater trochanter is a large bony eminence at the proximal femur that provides insertion of the powerful hip abductors (gluteus medius and minimus) and short external rotators (piriformis, gemellus superior, gemellus inferior and obturator internus) of hip[1, 2].

The lesser trochanter is a posteromedial bony eminence at the inferior aspect of the intertrochanteric ridge that provides attachment to the iliacus and psoas hip flexors. Iliacus and psoas act on the proximal fragment of a subtrochanteric femur fracture.

The attachment of muscles around the hip contribute to the powerful forces that act on the individual fragments in the subtrochanteric fractures, resulting in a flexed, abducted, and externally rotated position[1, 2, 4, 5].

The distal fragment is shortened and adducted by the hamstrings and hip adductors, resulting in an overall varus and anterior apex deformity at the fracture site.

Surgical exposure of subtrochanteric region involves either splitting the vastus lateralis or reflecting it from lateral intermuscular septum.

During surgical exposure, there may be profuse bleeding from perforating branches of the profounda femoris artery.

The major neural structures like sciatic and femoral nerves are rarely involved in closed injuries in the subtrochanteric region.

BIOMECHANICS

Joint reaction forces at the hip result from the compressive forces of the body's weight and most importantly the forces generated by the muscles that cross the hip[1].

Subtrochanteric posteromedial femoral cortex 1-3 inches below the lesser trochanter is the most highly stressed region of the body, with forces exceeding 1200 lb/in^2 in a 200 lb individual[6].

Strain – gauge studies in vivo (Schatzker et al 1980) confirmed Pauwel's and the AO/ASIF contention that the bending forces cause the medial cortex to be loaded in compression and the lateral cortex in tension[7].

These high compressive forces medially explain the high instance of implant failure and complications in these fractures[2]. Thus, we have to restore the medial buttress if not the internal fixation devices are subjected to bending stresses, and the loads are concentrated in this high stress area[8].

On restoration of the medial buttress, the internal fixation devices act as a tension band on the lateral femoral cortex.

Medial buttress is important to minimize implant stress and fatigue failure[9, 10, 11, 12] and hence restoration of medial cortex should be given the foremost importance in treatment of subtrochanteric fractures.

EVOLUTION OF TREATMENT

NON OPERATIVE TREATMENT

In 1891- Allis[13] analyzed the deforming forces and difficulty in obtaining satisfactory reduction in subtrochanteric fracture with longitudinal traction.

In 1967- femoral cast bracing was popularized by Sarmiento[14] (1960 – 1970). According to Sarmiento, cast bracing is not indicated for proximal femoral fractures.

In 1978- Velasio[15] reported upto fifty percent of unsatisfactory results with femoral cast bracing (significant shortening, varus, valgus deformity and persistent peroneal nerve palsy).

In 1981-The use of 90 – 90 traction, followed by modified cast brace[16, 17] with pelvic band to prevent this angulation has been reported by De Lee[18], Rockwood *et al*. in 1981.

OPERATIVE TREATMENT

In 1940 – 1950 – Jewett[19] Nail was probably the most frequently used device for subtrochanteric fracture. Because of uncontrolled fracture impaction there is increased failure rate, and hence Jewett Nail was slowly discontinued (Teitge 1976).

In 1967- Zickel[21, 66] introduced an intramedullary device that provides supplementary internal fixation by means of a screw into the head and neck fragments.

In 1976- Kunderna, recommended Ender's condylocephalic Nail. It is best suited for simple transverse or oblique fractures with little comminution. But it is of little use in extensive comminution and segmental loss cases, incidentally which accounts for majority of subtrochanteric fractures[7].

In 1980- Schatzker[22] and Wadell used 95° condylar plates which was biomechanically more suited for these fractures.

In 1985 - Grosse and Kempf reported a large series of patients treated by closed nailing with the locked intramedullary nail[23, 24]. Locked intramedullary nail is the best example of biological internal fixation. It provides both rotational and axial stability[7]. But with 1st generation locked intramedullary nail, securing proximal locking was very difficult.

In 1986 - Russell – Taylor reconstruction nail[25] was introduced as a device that would address all the subtrochanteric fractures. This secures the proximal locking by means of 2 screws which must enter the femoral neck and head.

In 1989 - The indirect method of reduction using 95° condylar plate and femoral distractor produced better fracture healing as evidence shown by Kinast[26] *et al*. The Dynamic condylar screw has found increased application in subtrochanteric fractures, especially in very proximal fractures (A.O. Manual, III Edition 1991)[27].

In 1992 - Wiss and Brien[28] clearly showed that the centromedullary nail could be used with a very high rate of success with fractures at or below the lesser trochanter.

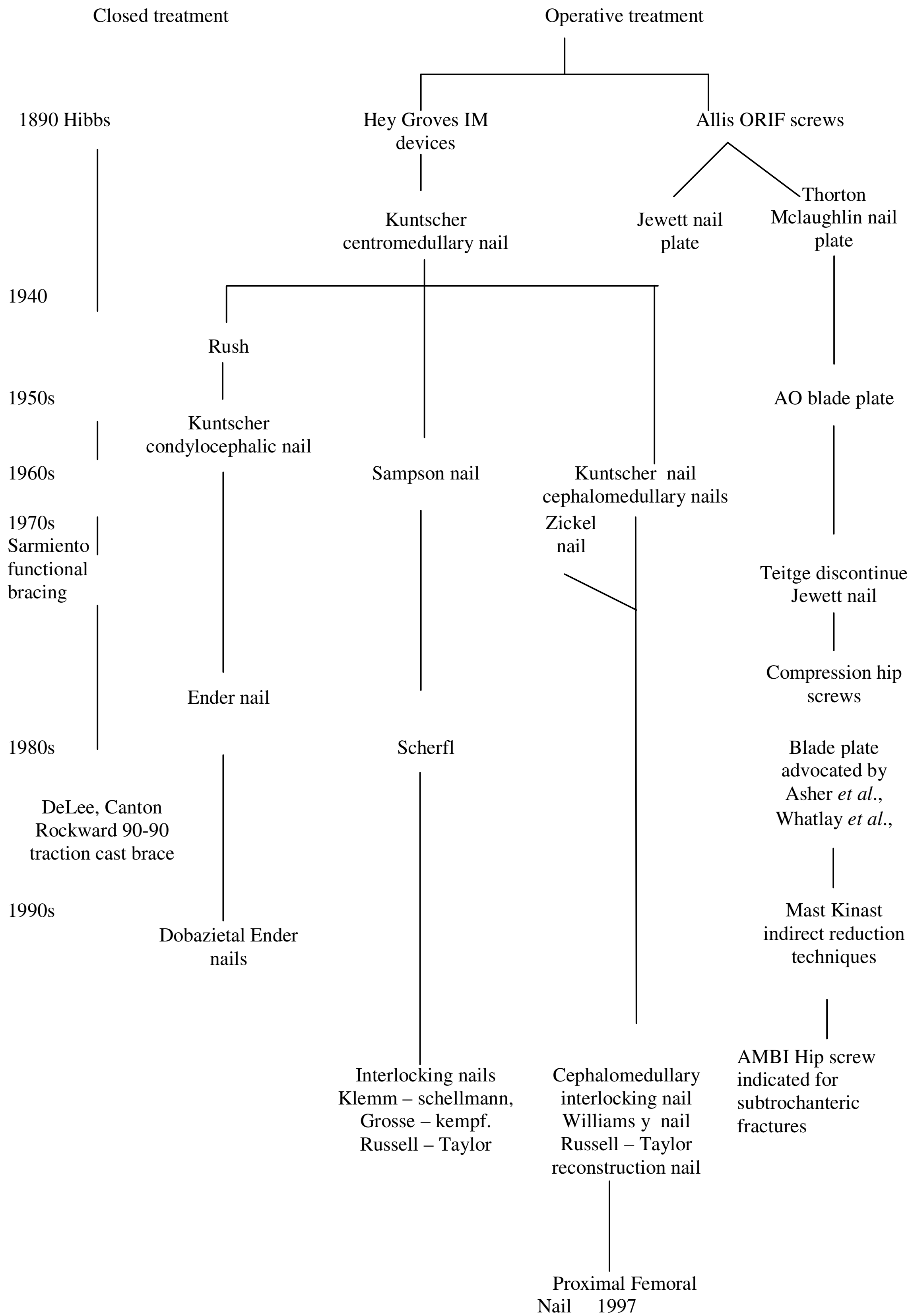
In 1997, Synthes introduced Proximal Femoral Nail, best suited for subtrochanteric fracture with lesser trochanter involvement. Because of the tapering nature of the nail[7], there is decreased chance of post surgical femoral shaft fractures.

In 1998 – Rantanen[29] J. Aro compared gamma nail and intramedullary hip screw.

In 2000 - Van Doorn[30], R., Staper J.W. used long gamma nail for subtrochanteric fractures. In 2000-Kulkarni SS, Moran CG.[31] studied the use of dynamic condylar screw for subtrochanteric fractures.

In 2003- Vaidya SV., Dholakia DB., Chatterjee A.[32] demonstrated the use of a dynamic condylar screw and biological reduction techniques for subtrochanteric femur fracture.

EVOLUTION OF TREATMENT



REVIEW OF LITERATURE

1. INCIDENCE

Subtrochanteric fractures account for approximately 7% to 34%[1, 2] of all proximal femoral fractures. According to Boyd and Griffin[38], Subtrochanteric fractures represent 26.7% in their series of 300 hip fractures. According to Comfort and Velasco, in their retrospective analysis, there was a bimodal age distribution for these fractures (63% occurred in patients between 51 – 70 yrs and 24% between 17 and 50 yrs).

2. MECHANISM OF INJURY

In younger patients the fracture is more commonly caused by high energy trauma[15, 33], such as road traffic accident. In older age groups, the fracture occurs with low energy trauma[15, 33] such as simple fall. The third group is those with subtrochanteric fractures occurring as a result of pathological state of the bone (primary neoplastic process or metastatic bone disease).

When subtrochanteric fracture is due to low energy trauma, it

1. Frequently occurs in more osteoporotic bone with wide medullary canal and thin cortices (old age group).
2. Is usually minimally comminuted.
3. Is usually spiral in configuration.
4. Is accompanied with less damage to soft tissue.

When a subtrochanteric fracture is due to high energy trauma, it has the following features:

- Seen in younger age group.
- Comminution over large area of proximal femur.
- Associated with significant soft tissue damage (even in closed injuries).
- Frequently compromise the vascularity of the fracture fragments.
- Mode of violence: Direct lateral force to the proximal thigh (like a side impact from road traffic accident) or axial loading failure in subtrochanteric region.
- Usually results in transverse, short oblique or spiral fractures with comminution.
- Significant hemorrhage into the soft tissues (Traumatologist should be attentive to the possible complications of haemorrhage and also compartment syndrome).

3. ANATOMIC AND FUNCTIONAL CONSEQUENCES OF INJURY

The normal femoral neck shaft angle[2] is 127° – 130°, which is decreased in Subtrochanteric fracture. Due to this, the distance between the head and the shaft is increased, which increases the moment arm and the bending forces across the fracture and may produce varus collapse[2]. If this deformity is not properly corrected this will cause a significant limp and an abductor lurch because of shortened working length of the abductor muscles. Hence the goals of subtrochanteric fracture management are:

1. Restoration of normal length and rotation of femur.
2. Correction of femoral head and neck angulations to restore adequate tension to abductor muscles.

4. COMMONLY ASSOCIATED INJURIES

Associated injuries with low energy trauma:

- Significant associated injuries are unusual.
- Contusions and abrasions are most common.
- Cranial and vertebral injuries must be considered (due to age factor).

Associated injuries with high energy trauma:

- Mostly associated with polytrauma (Total system examination is warranted).
- Mostly associated with injuries to the pelvis, long bones, spine and viscus (Bergman)[34].
- Associated injuries to cranium, thorax and abdomen may require surgical treatment (Wadell)[11].
- There is a high incidence of ipsilateral Patellar and tibial fractures.

5. DIAGNOSIS

History

Determine whether the fracture occurred from high or low energy trauma.

Physical examination

- Shortened extremity
- Swollen thigh
- Rotation of the foot results from loss of continuity at the fracture site.
- Inability to move the hip
- Neurologic and vascular deficits are unusual unless associated with penetrating injury usually seen with high energy trauma.
- Prominence of proximal fragment as a result of flexion, abduction and external rotation.

In addition, in low energy trauma, consider the possibility of a pathologic fracture secondary to neoplasm or metabolic bone disease.

Radiographic imaging

Radiographic evaluation consists of:

1) Anteroposterior and cross- table Lateral radiographs centered on the hip.

2) Anteroposterior and Lateral Radiographs of entire femur

- to assess any other fractures in the femur more distally
- to assess the most proximal extent of the fracture
- to assess involvement of piriformis fossa
- to detect any trochanteric extension of the fracture.

3) Full length views of the unaffected femur from hip to knee is essential to see the diameter of medullary canal, the curvature of the femoral shaft and the neck-shaft angle.

CLASSIFICATION

The ideal classification for any fracture should have the following qualities. It should:

1. Guide treatment plan
2. Indicate prognosis and complications that may occur
3. Aid in communication
4. Facilitate documentation

The introduction of various classification systems gives some insight into the evolution of treatment options and uncertainty regarding the treatment and prognosis of this complex fracture.

1) Fielding and Magliato
2) Seinsheimer's classification
3) Russell – Taylor classification
4) AO Classification
5) Boyd and Griffin

FIELDINGS CLASSIFICATION[35]

It is a pure anatomical classification that describes the position of major fracture line with respect to the lesser trochanter[36].

Type I : At the level of lesser trochanter.

Type II : Between 2.5 cm and 5 cm below the lesser Trochanter

Type III : From 5 cm to 7.5 cm below the lesser trochanter

Transverse fractures fits well with the classification. In the case of oblique and comminuted fractures, it should be classified according to, where the major portion of the fracture occurs. Usually, fractures at the upper level have a better prognosis for union than those at the lower level.

SEINSHEIMER CLASSIFICATION[37]

It is based on the number of fragments and the location and configuration of the fracture line. It mainly takes into account the factors affecting the stability of the fracture[36].

Type I : Non displaced or those with less than 2 mm of displacement

Type II : Two part fractures

II a : Transverse

II b : Spiral configuration with lesser trochanter attached to proximal fragment.

II c : Spiral configuration with lesser trochanter attached to distal fragment.

Type III : Three part fractures.

III a : Three part spiral configuration with lesser trochanter a part of the third fragment.

III b : Three part spiral configuration with the third part a butterfly fragment.

Type IV : Comminuted with four or more fragments.

Type V : Subtrochanteric-Intertrochanteric configuration

This classification offers guidelines for management and prognosis. According to Rockwood and Green[36], this Seinsheimer classification is the most useful of the available subtrochanteric fracture classifications in clinical practice to assist with decision making and predicting prognosis.

RUSSELL – TAYLOR CLASSIFICATION[33]

It is based on the integrity of the piriformis fossa.

Type I : Fractures do not extend into piriformis fossa

I a : Comminution and fracture line extend from below lesser trochanter to femoral isthmus

I b : Comminution and fracture line involve area of lesser trochanter to isthmus.

Type II : Fractures extend proximally into greater Trochanter and involve piriformis fossa.

II a : Without significant comminution or fracture of lesser trochanter.

II b : With significant comminution of medial femoral cortex and loss of continuity of lesser trochanter

But now, after better understanding of the entry point anatomy and availability of implants with improved designs, integrity of the piriformis fossa to nailing is of least important.

AO CLASSIFICATION

Subtrochanteric area[29] is defined as a part of diaphysis delineated superiorly by a transverse line passing through the inferior edge of lesser trochanter medially and distally by a transverse line 3 cm distal to the lesser trochanter.

BOYD AND GRIFFIN CLASSIFICATION[38]

This classification includes all fractures from extracapsular part of the neck to a point 5 cm distal to the lesser trochanter.

Type – I	:	Fracture extending along the intertrochanteric line.
Type – II	:	Comminuted fractures, the main fracture being along the intertrochanteric line but with multiple fractures in the cortex.
Type – III	:	Fractures that are basically subtrochanteric with atleast one fracture passing across the proximal end of the shaft just distal to or at the lesser trochanter.
Type – IV	:	Fractures of the trochanteric region and the proximal shaft with fracture in atleast two planes.

Type III and Type IV will have subtrochanteric components. Type III and Type IV comprise only one third of trochanteric fractures (Boyd and Griffin series).

MANAGEMENT

Since there is no gold standard treatment for subtrochanteric fracture, various treatment modalities have been attempted by various surgeons claiming different success rates. Even today the treatment modalities ranges from conservative treatment to the latest Proximal Femoral Nail[7, 9], each modality used according to the preference of the surgeon.

CONSERVATIVE METHOD OF TREATMENT

Conservative treatment is indicated in

1. In severely comminuted subtrochanteric fractures.
2. Associated with open injuries
3. In elderly patients in whom the bone quality is so poor that there is no hope of stable fixation.

In general, conservative treatment includes :

1. Buck’s traction
2. External fixation
3. Plaster spica immobilization, cast bracing[14]
4. Russell balanced traction
5. Skeletal traction

Traction

90 – 90 traction was originally devised by Obletz (1946) as an aid to the operative and early post-operative management of compound fractures of the femur with wounds on the posterior aspect of the thigh, sustained in the battles in North Africa during world war II.

It can be used when a Steinmann pin is placed either through the lower end of femur or the upper end of tibia.

Three methods are used:

1. Using a Tulloch Brown U loop.
2. Using a second Steinmann pin (lower end of Tibia)
3. Using a below knee plaster cast.

According to De Lee[18] (1982) skeletal traction is applied through lower femoral pin and appropriate adjustments are made under radiographic control, until satisfactory reduction is obtained (less than 5° varus or valgus angulation, 25% contact between fracture fragments on both views, overriding of less than 1 cm). After 3-4 weeks, once the symptoms subside, the limb is abducted to prevent, varus angulation. After early radiological evidence of union, patient is placed in a cast brace with pelvic band. Then weekly radiographic evaluation is necessary to prevent displacement and for documentation.

OPERATIVE METHOD OF TREATMENT

Dynamic Hip Screw

The Dynamic hip screw[22, 29, 39] is a telescoping device consisting of a cannulated lag screw which has a short head with deep threads and blunt tip. It permits deeper insertion of the screw without fear of later penetration of the joint. It allows controlled collapse at the fracture site. Compression hip screws are designed to obtain intrinsic stability by load sharing until the union is complete.

The ability of the screw shaft to slide in the collar of the plate allows :

1. Impaction at the fracture site.
2. Prevent collapse of medial buttress and varus displacement.

To get sliding effect, the plate must not be fixed with screws into the proximal fragment; valgus reduction, medial displacement of the shaft and insertion of only the lag screw into the proximal fragment promote impaction of the fracture (Ruff and Lubber 1986). This improves weight bearing capacity of the implant by reduction of the moment arm and maximizes bony contact, hence fracture stability, thereby decreasing implant failure. Although problems with varus positioning and fracture healing are largely prevented, extensive shortening due to collapse is still a complication encountered with use of the compression hip screw.

This fixation device has gained popularity because of the strength of the plate and because it allows for the insertion of guide wires, whose position can be checked through image intensifier when inserting the screw into the proximal fragment.

Reconstruction of medial buttress is as important as in any other method of internal fixation. In case of medial comminution, bone graft should be placed medially to relieve stress on the implant and to hasten fracture union.

The proper indication for this device should be those fractures that are comminuted and proximally based but do not extend distally.

Fixed angle condylar plates

It is a single unit which can provide a very stable internal fixation. There are two AO/ASIF angle plates (95° condylar plate and 130° pertrochanteric plate). 130° angle plate is used only for low subtrochanteric fracture. 95° condylar plate[44] is the one most commonly used. The purchase of the plate within the proximal femur is not sufficient by itself. Hence it must be supplemented, atleast with one screw passed through the plate portion into the proximal fragment. Condylar plate do not require radiographic control for insertion but are inserted under direct visual control, using only bony land marks and appropriate templates and guide wires as directional guides. This permits the surgery that can be carried out in on ordinary operating table. Full manipulation of leg facilitates the reduction and fixation of spiral and oblique fractures and their butterfly fragments. However placement of the 95 degree blade plate is a technically demanding procedure because the surgeon is required to place the blade in three planes simultaneously. Sanders and Regiazzori (1989) reported a 28 – 39 per cent complication rate.

This implant is best suited for those fractures that are slightly more distal in the subtrochanteric region so that an accessory cancellous screw can be inserted beneath the blade into the calcar to achieve a more stable construct.

Dynamic condylar screw

Condylar screw with 95° side plate was developed primarily for the treatment of supracondylar and intercondylar fractures of the femur. This device has been adopted for use in the proximal femur.

Roy Sanders and Piettro from Switzerland, said that because it is essentially a cannulated blade plate that required alignment only in two planes. They were hopeful that the DCS[31, 40, 41] would prove easier to insert and mechanically as effective as 95° condylar plate. After a study of 22 fractures treated with DCS, they concluded that the DCS was an excellent alternative to the 95° condylar plate. Its bending rigidity is two times that of condylar blade plate.

Regazzoni *et al*. (1985) and Tenbiner *et al*. (1983) have showed that relatively bulkier DCS has a higher yield strength (+63%) and superior fatigue strength (+56%) compared with angled plate.

In the proximal femur, 95° implant may be stronger biomechanically than the 130° implants because, it allows additional screw fixation into the proximal fragment. The lag screw has large threads for better and stronger purchase in the proximal fragment.

For transverse, short oblique or long oblique subtrochanteric fracture, with the lesser trochanter avulsed, DCS device is optimal (Sanders and Regazzori (1989).

Redford and Howell in 1992 reported the use of DCS in either pertrochanteric fractures with subtrochanteric extension or subtrochanteric fracture too high for the interlocking nail, with acceptable results.

Biological fixation by indirect reduction gives better results as compared with that of the interlocking nail.

Advantages of the DCS

1) DCS was mainly developed as an alternative implant to 95° condylar plate.
2) Easier to insert correctly, as it is inserted over a previously positioned guide wire.
3) Provides higher stability and firmer fixation and has increased strength and resistance to stress failure.
4) Allows early weight bearing and shows a lower complication rate than the static implant.
5) The alignment of the plate with the femoral shaft in the anteroposterior plane can be altered by turning the screw in contrast to condylar blade plate.

6) It is capable of revising non union, implant failures (DCS screw being intact) by a simple plate exchange alone.

7) It allows shorter operating time and hospital stay.

INTRAMEDULLARY DEVICES

Condylocephalic Nail

Indication for this Condylocephalic Nail (Enders Nail)[42] in subtrochanteric fractures is patients with traumatized skin over the proximal hip area that makes incisions for either hip compression screws or closed nailing procedures undesirable.

Transverse or short oblique fractures with minimal comminution are most suitable for this type of fixation.

Disadvantages

1) Post operative traction is needed for several weeks.

2) Loss of fixation is frequent complication as it is not a stable fixation.

Interlocked Intramedullary nail

The intramedullary devices[23, 24] have a shorter moment arm and the bending stress on them is less than in extramedullary devices. In fractures of the subtrochanteric region, the medullary canal and the trochanteric area do not provide stable purchase for the proximal fragment. This results in varus angulation of the proximal fragment and frequently rotational instability of the distal fragment.

Interlocking nail is useful in subtrochanteric fractures. For proximal fixation in subtrochanteric fracture, the Zickel nail provides improved fixation. Its use is technically difficult. Technical complications include trochanteric comminution, rotational malalignment of femoral shaft and perforation of head and neck of femur. Zickel nail does not provide distal locking.

The reconstruction (Russell – Taylor)[43, 44] nailing allows length and rotational control even when the lesser trochanter is not intact. Involvement of the piriformis fossa, the entry point for this device, does not contraindicate its use.

First generation interlocking nails[45, 46] can be used in subtrochanteric fractures below the level of lesser trochanter. But when it is used for more proximal fractures, there is increase incidence of implant and proximal screw failures. Further, most first generation nails provided inadequate fixation if the fracture extended above the level of the lesser trochanter. Proximal locking is difficult in these nails.

These problems led to the development of a new generation of interlocked nails that provided better fixation by directing screws into the head of the femur. These implants are called reconstruction[43, 44] or second generation nails. They have an increased wall thickness proximally, stronger and large proximal screws and reliable proximal targeting devices. It has additional 8° of anteversion to facilitate screw into head hence it necessitates separate nail for right and left. 2 screws in the proximal part of the nail.

1. 8 mm bolt low in the femoral neck.
2. 2nd 6.4 mm screw in upper aspect.

If the fracture comminution involves the greater trochanter or the region of piriformis fossa, nail with entry point in trochanter is preferred (Gamma nail)[30, 41, 47, 48, 49]. In complex fractures angle blade plate is an alternative.

Proximal femoral nail :

PFN is considered to be the second generation ILIM nail , was introduced during 1997 by Synthes company in Czech Republic for treatment of unstable peritrochanteric fractures. PFN is 240 mm in length and is made of 316 LVM stainless steel or titanium. 2 proximal screws can be inserted into the femoral neck through the proximal part of the nail. The tip of the load bearing neck screw should be placed subchondrally into the distal half of femoral head. The other screw is a derotation – proximal pin and should be placed through the upper part of the nail into the proximal half of the femoral neck to prevent rotation of the head and neck fragment. 2 distal interlocking bolts of 4.9 mm size is inserted through the distal part of the nail connecting the lateral and the medial cortex of the shaft. It has both dynamic and static locking .

OPERATIVE TECHNIQUE

PROXIMAL FEMORAL NAIL

Implants and Instrumentation

The indigenous proximal femoral nail is an Indian version of the original European PFN (Synthes)

- which has a proximal diameter of 17.5 mm
- load bearing femoral neck screw of 11.0 mm

It was modified to 15.0 mm for proximal diameter and 8.0 mm for load bearing femoral neck screw to suit the proximal femora of Indian patients.

Implant

- Length of indigenous PFN --240 mm
- Proximal diameter --15.0 mm
- Distal diameters --9 , 10 , 11 & 12 mm
- Self tapping derotation – hip pin -- 6.0 mm(50, 55, 60 to 110 mm size)
- Self tapping load bearing femoral neck screw(Lag) - 8.0 mm (50,55, 60 to 110 mm size)
- Distal locking bolts (2 nos.) --4.9 mm
- 135° angled proximal holes for cervical screws

Surgical Technique

ANAESTHESIA

Spinal/General Anesthesia

POSITION

Supine in a standard fracture table. Rest both feet in a padded foot holder and use a padded perineal post. The pelvis must lie in the horizontal position. Adduct the affected femur to allow access to trochanteric region. Abduct the unaffected limb while adducting the trunk and affected extremity. Tilt the trunk away from the fracture and strap the arm on the same side across the chest of the patient. Place the uninjured side flexed and abducted to allow unimpeded access to the image intensifier between the legs.

REDUCTION TECHNIQUE

Fractures were reduced with initial closed reduction by slight internal rotation of the femur with traction. The alignment of the medial cortex in AP view and reduction of the proximal fragment and shaft fragment in lateral view is checked.

INCISION

Lateral linear incision of 5 to 6 cm size extending proximally from the tip of greater trochanter, followed by splitting of aponeurosis of the gluteus maximus in line with its fibres and careful splitting of gluteus medius in the line of its fibres.

ENTRY POINT

The point of entry is made just medial to the tip of trochanter at the junction of its anterior one - third and posterior one - third with a curved bone awl.

GUIDE WIRE INSERTION AND REAMING

The guide wire is inserted using a tissue protector and a guide pin – centering sleeve well beyond the subtrochanteric region. The position of guide wire is checked in AP and lateral views. The 15 mm cannulated proximal femoral reamer is used to ream the proximal femur for up to 7 cm . Distal reaming of the femoral canal is done with graded cannulated reamers up to more than 1 size of the distal diameter of the nail.

NAIL INSERTION AND PROXIMAL TARGETING

The nail is inserted with the help of the jig over the guide wire by hand by gentle twisting movements and the progress of the nail is done under image intensifier control. Once the nail is positioned appropriately, a stab incision over the lateral thigh the cervical guide pins for the load bearing cervical lag screw (8.0 mm)and for the derotation – hip pin were made and pins passed into the head and neck using the guide pin sleeves under fluoroscopic control in the desired position.

The guide pin is advanced to 5 mm from the articular surface of the femoral head and reaming is done using cannulated drill with a guide wire in situ. The load bearing cervical lag screw of adequate length is inserted into the subchondral bone upto 5mm from the articular surface with the screw driver under image control, followed by the insertion of derotation – hip pin of adequate length into the upper half of neck .

DISTAL TARGETING

Distal locking also is done with the aid of distal targeting guide by two 4.9 mm locking bolts after the position of the screws were confirmed with the C-arm.

CLOSURE

After removal of the jig, proximal wound is closed over a suction drain after approximating the gluteus medius fibres and the aponeurosis of gluteus maximus. The distal wounds were closed with skin sutures.

D.C.S. FIXATION

ANAESTHESIA

Under general anaesthesia or spinal or epidural anaesthesia.

POSITION

Patient in supine position on a fracture table.

PROCEDURE

- Fracture is reduced and confirmed with image intensifier.
- A long lateral Incision is made, skin, subcutaneous tissue fascia lata cut, vastus lateralis is split.
- Guide wire is inserted using 95° guide. Anteversion of the femoral neck is determined by sliding a ‘K’ wire along the femoral neck.
- Point of entry of guide wire is 2 cm distal to the tip of trochanter, 2 cm proximal to the vastus ridge at the junction of anterior 1/3 and posterior 2/3 of AP diameter of greater trochanter and parallel to the anteversion wire.
- Guide wire is inserted just short of the articular surface in the lower half on the femoral head.
- After checking the correct positioning of the guide pin with image intensifier, the length within the bone is measured directly with measuring device.
- The DCS triple reamer is set to the same length, passed over the guide pin and the hole is drilled and then tapped.
- The lag screw is inserted; at the end of the insertion T handle of the wrench must be parallel to the femoral shaft to allow the plate barrel to slide over the screw shaft.
- 95° plate with barrel is inserted & fixed with 4.5mm cortical screws.If there is comminution, bone grafting is needed.
- Close the wound in layers after keeping drain and achieving haemostasis.

POST OPERATIVE CARE

- Mobilized as soon as patient is stable.
- Stable fracture – partial weight bearing – immediate: full weight bearing – after bridging callus.
- Unstable fracture – weight bearing is delayed until bridging callus is formed, normally about 12 weeks[9].

COMPLICATIONS

1. Loss of fixation and implant failure[33, 50]

With the use of hip compression screw in osteopenic bone, risk of implant failure increases. Loss of fixation with interlocking devices is related to not using a static interlocking construct, not evaluating the entry portal into the piriformis fossa for comminuted fractures.

After failure of plate and screw fixation union is achieved by repeat open reduction and reapplication of internal fixation, coupled with autogenous iliac bone grafting.

Aronoff and colleagues recommended IM nailing for failed plates and screws.

2. Nonunion

Non union of a subtrochanteric fracture is generally indicated by an inability to resume full weight bearing in the usual 3 to 6 months period.

Non union is treated with an IM device in a static locking fashion. Bone grafting is needed. Non union with nailing is treated by repeat reaming and nailing with a larger nail.

3. Malunion

Malunion involves three aspects.

a) Angulation

Generally Varus angulation of $<5^{\circ}$ is well tolerated. If more, valgus osteotomy plus repeat internal fixation with bone grafting is indicated.

b) Leg length

Shortening is common with malunion in cases with excessive comminution.

c) Rotation

If rotation deformity is more, derotation osteotomy may be indicated.

4) Wound Infection

Infections if present, are generally evident between the 4^{th} and 10^{th} postoperative days. It is treated by immediate surgery for drainage and debridement of all necrotic material under the cover of antibiotics. Prolonged antibiotic therapy typically for 6 weeks followed by long term oral antibiotics is indicated.

5) With PFN:

Superior lag screw cut out, varus deformity, gluteus medius tendon injury and abductor lurch are some of the complications associated with proximal femoral nail.

MATERIALS AND METHODS

The purpose of the study is to evaluate the functional outcome of closed subtrochanteric fractures managed surgically in Government Royapettah Hospital/Kilpauk Medical College, Chennai from June 2006 to November 2008.

A total of 20 patients were taken up for the study.

The pre-requisite for the inclusion in the study was a minimum of 6 months follow-up evaluation period. Reduction was considered acceptable when the anatomic configuration of the hip was restored and continuation of the medial cortex was re-established. If neither of these were achieved, the reduction was deemed unacceptable. Union was defined by radiographic criteria consistent with clinical examination or both. The majority of the patients were operated when their general condition was stable, mostly within a week. Few were postponed for their medical problems or associated injuries. Prophylactic antibiotics were given at the time of skin incision.

For DCS/angle blade/DHS/ reconstruction fixation/Proximal Femoral Nail we prefer supine position in fracture table. We prefer lateral approach. We prefer bone grafting for severely comminuted fractures. In case of closed nailing no bone graft is needed.

Post operatively hip is mobilized from 4th Post-op day. If there is stable construct i.e., medial cortex continuation is restored, we advised partial weight bearing usually after 6 weeks. Then after bridging callus formation, full weight bearing is started, usually after 12 weeks. Even partial weight bearing is allowed only after bridging callus formation in unstable injuries.

We have followed Seinsheimer classification in our study.

Age in years

20 – 30	-	2
31 – 40	-	7
41 - 50	-	2
51 – 60	-	7
61 and above	-	2

Sex

Male	-	16
Female	-	04

Site of involvement

Right	-	11
Left	-	09

Seinsheimer classification

I	-	0

IIA	-	2
IIB	-	3
IIIA	-	5
IIIB	-	2
IV	-	4
V	-	4

Mode of injury

RTA	-	10
FALL	-	10

Associated injury

Fracture shaft of Humerus	-	1
Head injury	-	2
Colle's fracture	-	1
# Both Bones Forearm	-	1
# 5th Metatarsal	-	1

Mode of Treatment

PFN	-	7
DCS	-	7
DHS	-	3
95° Angled Blade plate	-	1
Reconstruction nail	-	2

Time interval

Within 7 days	-	13
8 – 14 days	-	5

CASE - 1

Name	:	Mr. Sekar
Age /Sex	:	56/Male
Mode of injury	:	Fall from height
Extremity	:	Right
Seinsheimer Diagnosis	:	II B
Time gap bet. inj. & surgery	:	5 days
Procedure	:	Proximal Femoral Nail
Post op. period	:	Uneventful
Non wt. bearing mobilization	:	4^{th} post op. day
Partial weight bearing	:	8weeks
Full weight bearing	:	12weeks

At follow up - 22 months

According to traumatic hip score by Sander et al.

Criteria	**Score**
Pain	8
Walking	10
Function	8
Muscle power	8
Daily activities	9
Shortening	10
Radiological evaluation	10
Total	**63**
Result	**Good**

CASE - II

Name	:	Mr. Saravanan
Age /Sex	:	36/M
Mode of injury	:	RTA
Extremity	:	Left
Seinsheimer Diagnosis	:	III A
Time gap bet. inj. & surgery	:	3 days
Procedure	:	PFN
Post op. period	:	Uneventful
Non wt. bearing mobilization	:	5^{th} day
Partial weight bearing	:	10 weeks
Full weight bearing	:	12 weeks

At follow up-19 months

According to traumatic hip score by Sander et al.

Criteria	Score
Pain	8
Walking	10
Function	10
Muscle power	10
Daily activities	10
Shortening	10
Radiological evaluation	10
Total	**68**
Result	**Excellent**

CASE - III

Name	:	Mr. Kanniappan
Age /Sex	:	45 /Male
Mode of injury	:	Fall
Extremity	:	Left
Associated Injury	:	Fracture Shaft of Humerus
Seinsheimer Diagnosis	:	IV
Time gap bet. inj. & surgery	:	4 days
Procedure	:	PFN
Post op. period	:	Uneventful
Non wt. bearing mobilization	:	4 days
Partial weight bearing	:	9 weeks
Full weight bearing	:	12 weeks

At follow up - 20 months

According to traumatic hip score by Sander et al.

Criteria	Score
Pain	8
Walking	10
Function	10
Muscle power	8
Daily activities	10
Shortening	10
Radiological evaluation	10
Total	**66**
Result	**Excellent**

CASE - IV

Name	:	Mr. Kuppan
Age /Sex	:	52/Male
Mode of injury	:	RTA
Extremity	:	Left
Associated injury	:	Colle's fracture
Seinsheimer Diagnosis	:	III B
Time gap bet. inj. & surgery	:	6 days
Procedure	:	PFN
Post op. period	:	Uneventful
Non wt. bearing mobilization	:	4thday
Partial weight bearing	:	6 weeks
Full weight bearing	:	11 weeks
Complication	:	Malunion

At follow up - 18 months Sander et al. Traumatic Hip Score

Criteria	Score
Pain	6
Walking	6
Function	6
Muscle power	6
Daily activities	5
Shortening	6
Radiological evaluation	6
Total	**41**
Result	**Poor**

CASE - V

Name	:	Mr. Ramalingam
Age /Sex	:	40/Male
Mode of injury	:	Fall
Extremity	:	Left
Seinsheimer Diagnosis	:	III A
Time interval between injury and surgery	:	7 days
Procedure	:	DCS
Post op. period	:	Uneventful
Non wt. bearing mobilization	:	6^{th} day
Partial weight bearing	:	8 weeks
Full weight bearing	:	13 weeks

At follow up - 8 months

According to traumatic hip score by Sander et al.

Criteria	Score
Pain	8
Walking	10
Function	8
Muscle power	8
Daily activities	9
Shortening	10
Radiological evaluation	10
Total	**63**
Result	**Good**

CASE - VI

Name	:	Mr. Narasimman
Age /Sex	:	65/Male
Mode of injury	:	Fall
Extremity	:	Left
Seinsheimer Diagnosis	:	IV
Time interval between injury and surgery	:	10 days
Procedure	:	DHS
Post op. period	:	Uneventful
Non wt. bearing mobilization	:	5^{th} day
Partial weight bearing	:	9 weeks
Full weight bearing	:	12 weeks

At follow up - 12 months

According to traumatic hip score by Sander et al.

Criteria	Score
Pain	6
Walking	8
Function	8
Muscle power	8
Daily activities	7
Shortening	8
Radiological evaluation	8
Total	**53**
Result	**Good**

CASE - VII

Name	:	Mr. Fazil
Age /Sex	:	40/Male
Mode of injury	:	RTA
Extremity	:	Right
Seinsheimer Diagnosis	:	V
Time interval between injury and surgery	:	6 days
Procedure	:	Reconstruction Nail
Post op. period	:	Delayed wound healing
Non wt. bearing mobilization	:	4^{th} day
Partial weight bearing	:	8 weeks
Full weight bearing	:	15 weeks
At follow up	:	6 months

According to traumatic hip score by Sander et al.

Criteria	Score
Pain	6
Walking	6
Function	6
Motion/muscle power	6
Daily activities	5
Shortening	6
Radiological evaluation	6
Total	**41**
Result	**Poor**

CASE VIII

Name	:	Mr. Shanmugham
Age /Sex	:	51/ Male
Mode of injury	:	Fall
Extremity	:	Left
Seinsheimer Diagnosis	:	IIb
Time interval between injury and surgery	:	5 days
Procedure	:	DCS
Post op. period	:	Uneventful
Non wt. bearing mobilization	:	4th day
Partial weight bearing	:	8 weeks
Full weight bearing	:	13 weeks

At follow up - 18 months

According to traumatic hip score by Sander et al.

Criteria	Score
Pain	10
Walking	10
Function	10
Muscle power	8
Daily activities	10
Shortening	10
Radiological evaluation	10
Total	**68**
Result	**Excellent**

RESULTS

In our study we have taken 20 patients with 20 subtrochanteric fractures. 7 patients were treated with Proximal Femoral Nail, 7 patients were treated with Dynamic Condylar Screw fixation. 2 patients were treated with Reconstruction nail. 3 patients were treated with Dynamic Hip Screw and 1 with 95^0 angled blade plate. Primary bone grafting was done in 4 patients who were treated by open reduction for Seinsheimer type IV and V.

We followed traumatic hip score by Sander's *et al.,* in our study.

Out of 7 PFN operated patients:

Excellent	-	4 (57%)
Good	-	2 (29%)
Poor	-	1 (14%)

Out of 7 DCS operated patients:

Excellent	-	2 (29%)
Good	-	4 (57%)
Poor	-	1 (14%)

Out of 2 patients treated with Reconstruction nail:

Excellent	-	1 (50%)

Poor - 1 (50%)

Out of 3 DHS operated patients:

Good - 3 (100%)

1 patient treated with 95 degree angled blade plate had

Failure - 1 (100%)

Out of 20 cases there were 2 cases(10%) of malunion

Many patients have occasional pain. Most of them walk without support. Mostly do their normal activities. Almost all patients have normal muscle power.

One failure case in 95 degree Angled Blade Plate was due to implant failure secondary to infection for which Implant removal was done and infection control achieved. Revision surgery was done with DCS and finally union achieved.

DISCUSSION

Subtrochanteric fractures are one of the challenging fractures to treat because it is subjected to high compressive force medially, high tensile forces laterally and enormous amount of bending forces.

The problems in subtrochanteric fractures are:

a) Anatomically the area consists of hard cortical bone with different healing characteristics than metaphyseal bone.

b) Due to high velocity injury, this bone is frequently comminuted.

c) Biomechanically proximal part of the femoral shaft is an area of high stress concentration.

d) The deforming forces about the hip, makes closed reduction difficult.

Now most authors advocate internal fixation of these fractures due to improvement in implants.

Due to better understanding and improvement in reduction techniques and advancement in image intensification techniques subtrochanteric fractures have now become simple with the aid of fracture table.

Reconstruction of medial cortex is the most important step in treating subtrochanteric fractures. But in many of these fractures, reconstruction of solid medial wall is not possible, due to comminution or bone loss. In these cases we must fill that medial gap with autogenous bone graft.

When there is medial comminution, there will be higher bending force on the laterally applied implant than centromedullary devices because centromedullary devices are closer to the line of joint reaction force than laterally placed implants (DCS, DHS, 95° ABP).

In our study, 9 patients were treated with centromedullary devices (PFN, Recon Nail), out of which 7 patients(78%) had good to excellent results. Of 11 patients who were treated with laterally placed implants(DCS, DHS, 95° ABP) out of which 9 patients (82%) had good to excellent results.

EL Santo et al.[41] compared the results of unstable subtrochanteric fractures treated with Gamma Nail and DCS, concluded that there were no significant differences in pain, range of movement or walking ability, but recovery was significantly earlier in the Gamma Nail group. In our study DCS and PFN showed equally good results. Mean age in their study is 70 years compared to 44.5 years in our study. In our study, we encountered one failure (5%) is due to infection and implant failure in 95° angled blade plate fixation. We had 2 cases of malunion(10%), one with 15° varus deformity and in one case malunion (8%) with 15° varus deformity compared to one implant failure (7%) and one malunion (9%) in their series.

Vaidya et al.[32] evaluated the use of DCS and biological reduction techniques for subtrochanteric fractures and concluded the use of indirect reduction techniques instead of anatomic open reduction has proven to be successful, especially in comminuted fractures. The mean age in our series is 44.5 year compared to 32 years in their series. In all the patients mode of injury was due to fall or RTA compared to 87% in their study. In our study patient treated with 95° ABP (patient no 9) had implant failure which had to be revised with DCS after controlling the infection which united eventually. Union was achieved in all case in our study compared to union in all cases in their study.

Roberts et al.[25] evaluated the biomechanical study of fracture site motion in second generation Intramedullary nailing of subtrochanteric fracture. He concluded that when subtrochanteric fractures are unstable and early weight bearing is desirable, the choice of implant is critical and should be restricted to long intramedullary implants that allow minimal fracture site motion.

Pelet et al. evaluated the results of osteosynthesis of subtrochanteric fractures by blade plate verses gamma nail. He concluded, gamma nail is preferred for subtrochanteric fracture management as it allows early weight bearing. Twenty six patients were treated with Gamma nail and blade plate. In our study 20 patients, 9 patients were treated with long intramedullary devices and early weight bearing was advised in all, average being of 5-6 weeks. In DCS / blade plate fixation, weight bearing is delayed till bridging callus formation usually after 9 weeks. Fracture healing was acquired at 4 months compared to 4. 2 months in their series.

A study by Neher et al.,[49] in treatment of subtrochanteric fracture using submuscular fixed low angle plate, concluded that submuscular application of fixed low-angle plate devices resulted in anatomic alignment of femoral neck shaft angle while maintaining low rates of implant failure and high rates of union. In their study, time for radiological union was averaged 91 days compared to 98 days in our study, time taken for clinical union was 107 days compared to 110 days in our study.

In a study by Krettek et al. minimally invasive percutaneous plate osteosynthesis (MIPPO) using the DCS in proximal and distal femoral fractures, concluded that the results of MIPPO technique are equal to that of subtrochanteric fractures treated by anatomical reduction and autogenous bone grafting. In their study 12 out of 13 cases healed without a second procedure, compared to all 7 patients fracture was united in our series. There was one implant failure (plate screw breakage) which required repeat fixation in their series compared to no implant failure in 7 cases in our series. At follow-up, there were 2 varus deformities more than 5°, compared to 1 varus deformity of 15° in our study, (Case No.10, Mr.Madhavan) operated with DCS right side had varus deformity at 7 months. We deferred weight bearing for 1 month and implant removed after one month, after fracture consolidation. There were 2 shortening over 20mm compared to 1 patient with 15mm shortening in our study.

In the management of subtrochanteric fracture for achieving successful outcome, good pre operative planning and execution is necessary.

Recent results indicate short centromedullary devices like PFN yield results comparable to DCS. This is essentially a closed procedure. Nowadays experienced surgeons use PFN in severely comminuted cases and obtain good results.

CONCLUSION

For the successful management of the subtrochanteric fractures reestablishment of medial cortex with maintenance of length and rotation are the most important factors.

- Centromedullary devices yield comparable results with DCS and being closed procedure this is a very good option nowadays.

- When anatomic reduction is attempted in comminuted fractures where open reduction is done bone grafting is used.

- In grossly comminuted fractures, closed ILIM nails such as PFN gives equally good results without bone grafting.

- Despite anatomic reduction the mode of failure in the Blade plate treated patient was due to plate or screw breakage rather than loss of fixation in osteoporotic bone. Hence closed Intramedullary nailing has slight edge over blade plate devices.

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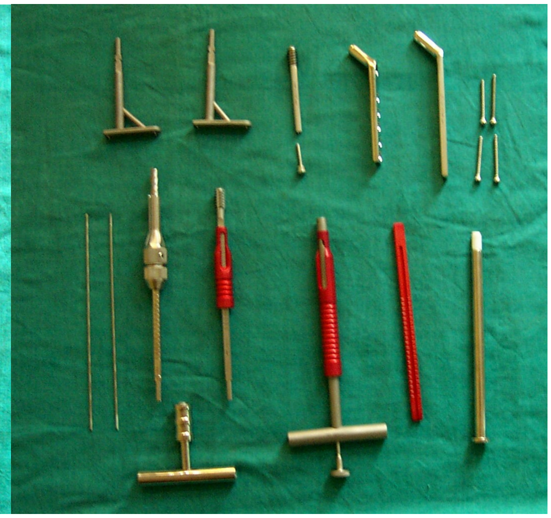
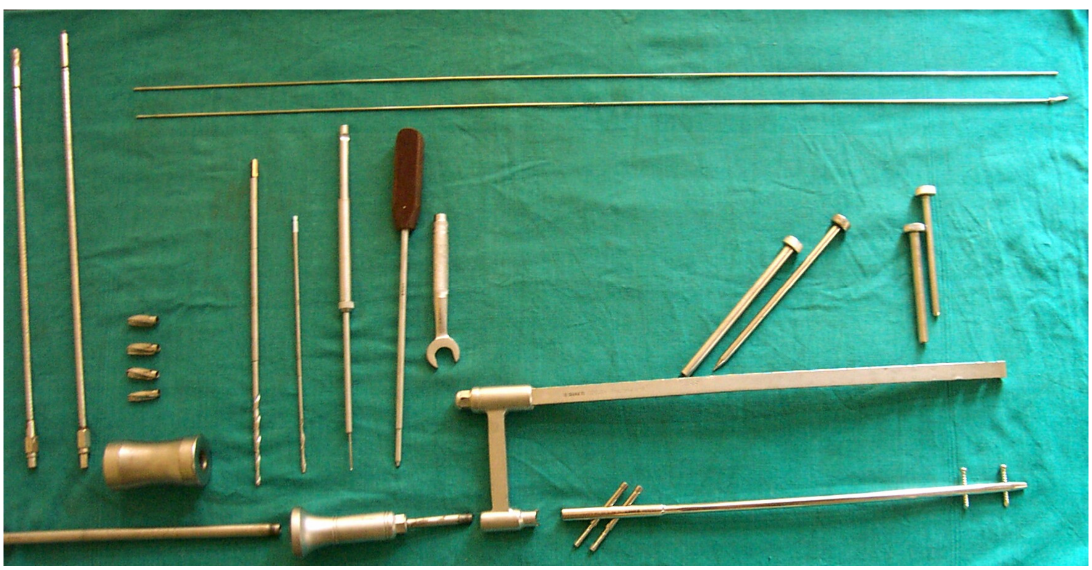
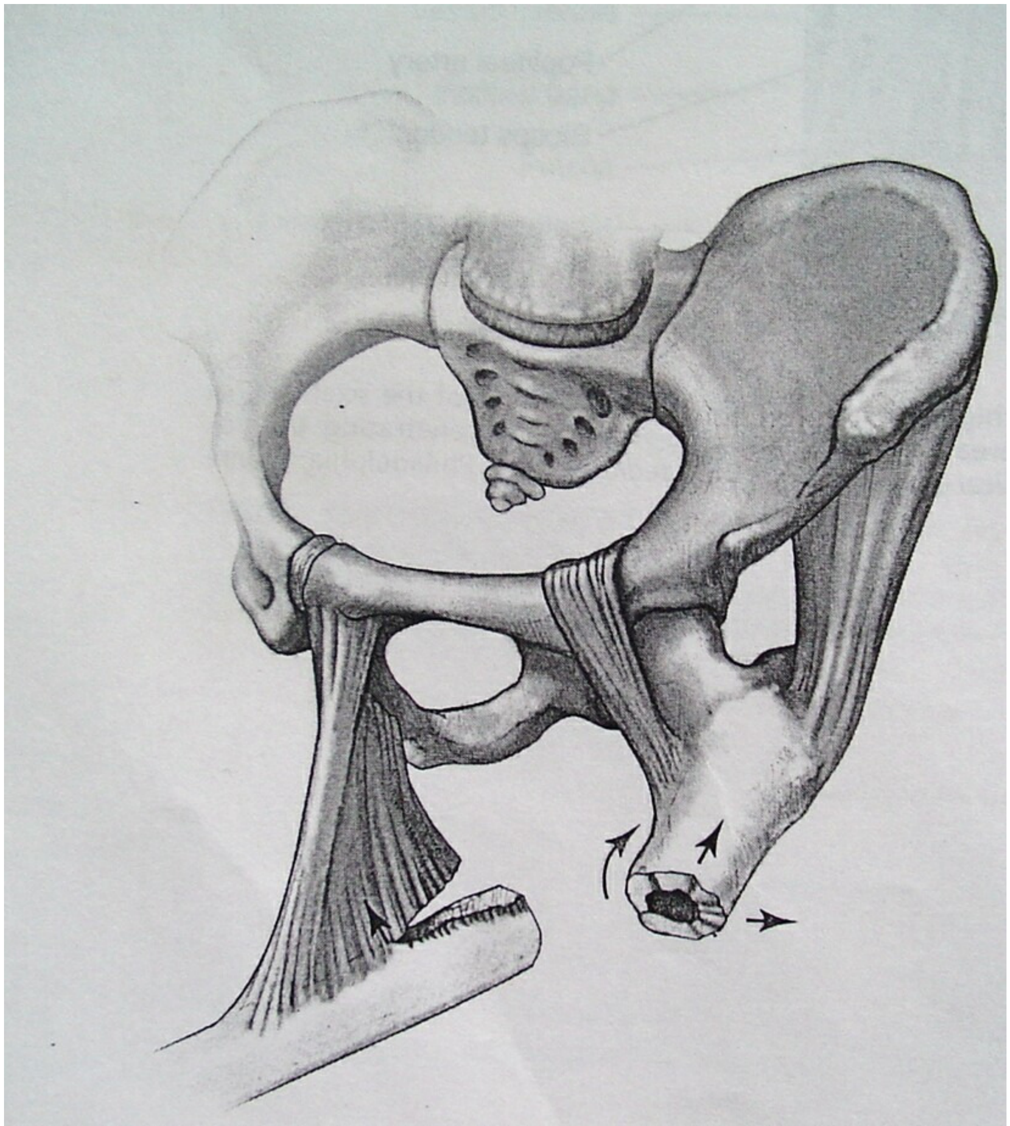
INSTRUMENTS AND IMPLANTS

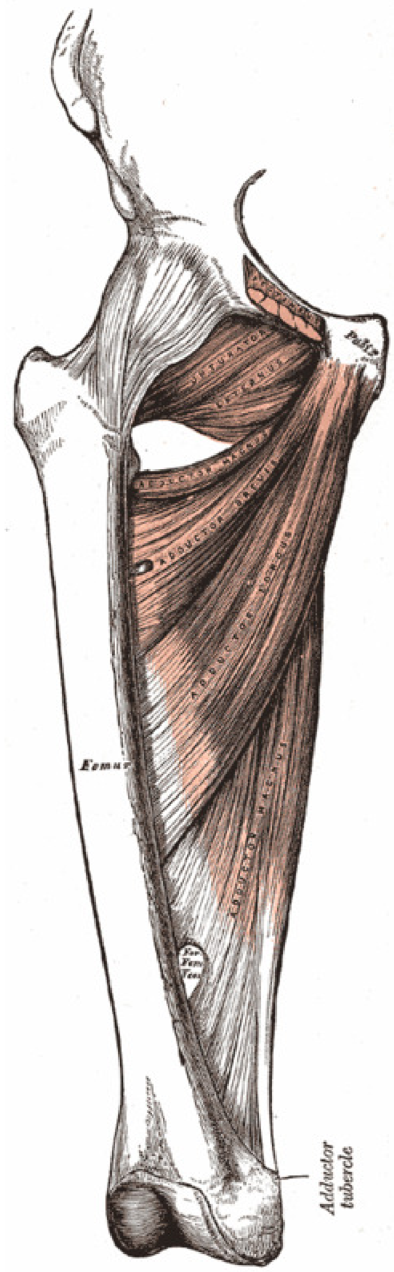
DCS **DHS**



RECONSTRUCTION NAIL

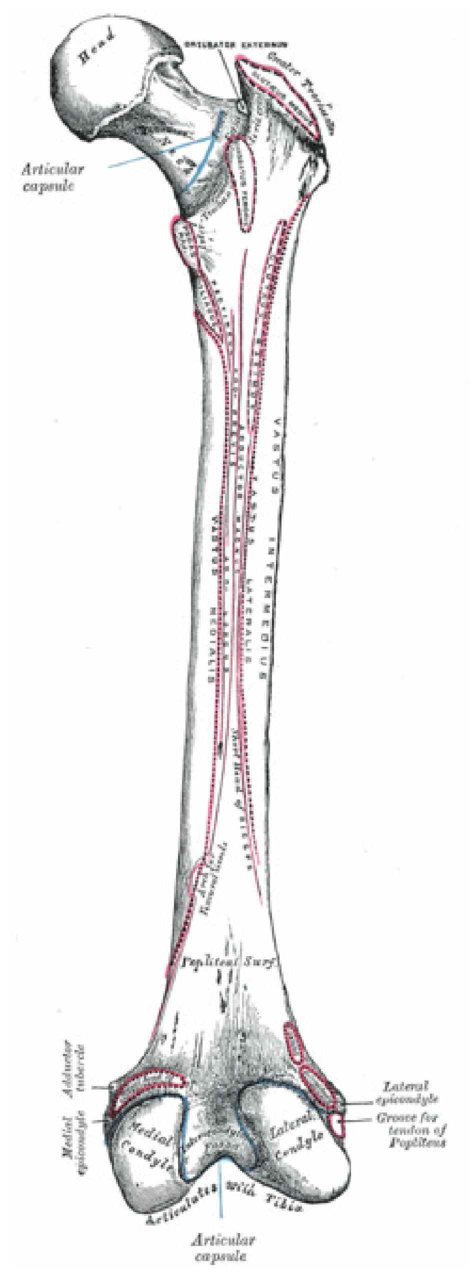


BIOMECHANICS

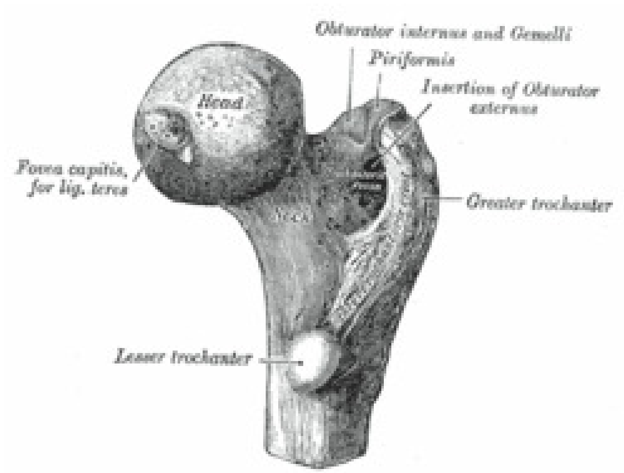


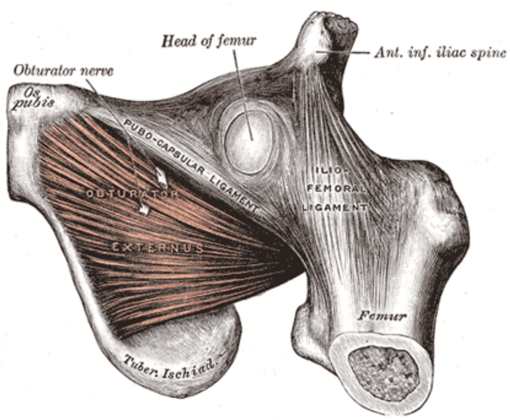
OBTURATOR EXTERNUS
ADDUCTOR BREVIS
ADDUCTOR LONGUS
ADDUCTOR MAGNUS
Pubis
Femur
Adductor tubercle

ANATOMY

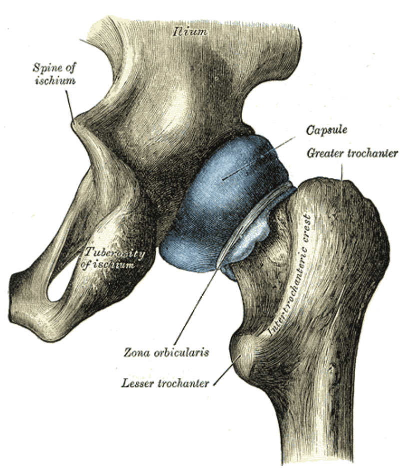

Head
OBTURATOR EXTERNUS
Articular
capsule
VASTUS INTERMEDIUS
LATERALIS
MEDIALIS
Popliteal Surf.
Adductor
tubercle
Medial
epicondyle
Medial
Condyle
Lateral
Condyle
Lateral
epicondyle
Groove for
tendon of
Popliteus
Articulates with Tibia
Articular
capsule

ANATOMY


Obturator internus and Gemelli
Piriformis
Insertion of Obturator externus
Head
Fovea capitis, for lig. teres
Greater trochanter
Lesser trochanter


Head of femur
Ant. inf. iliac spine
Obturator nerve
Os pubis
PUBO-CAPSULAR LIGAMENT
ILIO-FEMORAL LIGAMENT
OBTURATOR
EXTERNUS
Femur
Tuber. Ischiad.

HIP JOINT


Ilium
Spine of ischium
Capsule
Greater trochanter
Tuberosity of ischium
Intertrochanteric crest
Zona orbicularis
Lesser trochanter

TRAUMATIC HIP RATING SCORE

(Sanders et al)

No. of points		Criteria
I. Pain	0	Constant; unbearable; uses strong medication frequently
	2	Constant but bearable; uses strong medication occasionally
	4	Little or none at rest; with activities; uses salicylates frequently
	6	When starting, then better, or after a certain activity; uses salicylates occasionally
	8	Occasional and slight
	10	None
II. Walking (Gait)	0	Bedridden
	2	Uses a wheelchair; transfer activities with walker Uses one support, housebound
(Markedly restricted)	4	Uses one support, less than one block Uses bilateral support, short distances
(Moderately restricted)	6	Uses no support, less than one block Uses one support, up to five blocks Uses bilateral support, up to five blocks
(Mildly restricted)	8	Uses no support, limp Uses one support, no limp
(Unrestricted)	10	Uses no support, no appreciable and confined
III. Function A. Retired Preinjury	0	Completely dependent and confined
	2	Partially dependent
	4	Independent; can do limited housework; limited shopping
	6	Can do most housework, shops freely; can do desk-type work
	8	Very little restriction, can work on feet

No. of points		Criteria
	10	Normal activities
B. Employed Preinjury	0	Unemployed/ retired secondary to injury
	2	Part-time/light duty
	4	Changed jobs secondary to injury
	6	Altered job description somewhat
	8	Returned to work with some disability
	10	Returned to full work
IV. Motion – Muscle Power	0	Ankylosis with deformity
	2	Ankylosis with good functional position
	4	Muscle power poor to fair and of flexion $<60^0$ restricted lateral and rotary movement
	6	Muscle power fair to good; art of flexion as much as 90^0 restricted lateral/ rotary motion
	8	Muscle power good or normal; arc of flexion $>90^0$; fair lateral and rotary movement
	10	Muscle power normal; motion normal or almost normal
V. Daily activities		
A. Indian Footwear	0	Unable
	3	With difficulty
	5	With ease
B. Stairs	0	Unable
	2	One at a time
	4	With railing
	5	Normal
VI. SHORTENING		
	0	Gross - >4cm

No. of points		Criteria
	2	>= 3cms to <4cms
	4	>=2cms to <3cms
	6	>=1cms to <2cms
	8	<1cm
	10	No LLD
VII. Radiographic evaluation	0	Nonunion/ plate failure/ arthritis
	2	Delayed union
	4	Varus> 10^0, shortening >2.5 cm
	6	Varus >5^0 but <10^0, shortening >1cm but <2.5 cm
	8	Varus <5^0 shortening< 1 cm
	10	Anatomic reduction
TOTAL SCORE		**RESULT**
65 – 70		Excellent
45 – 64		Good
35 – 44		Poor
< 35		Failure

PROFORMA

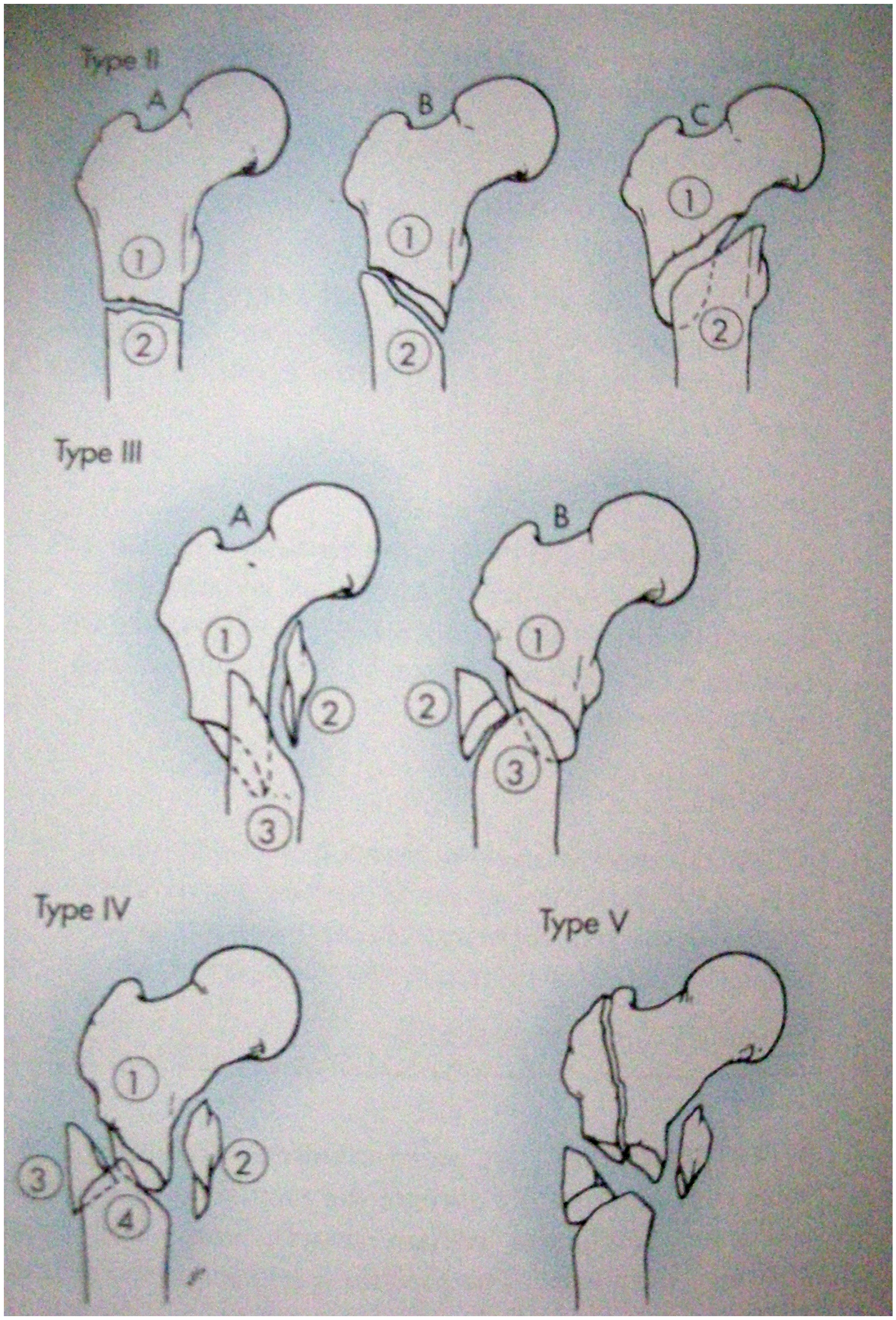
1.	Patients Name	:	
2.	Age	:	
3.	Sex	:	Male / Female
4.	Occupation / Income	:	
5.	Address	:	
6.	Associated Medical Illness	:	DM/HT/TB/IHD/Any other
7.	Mode of Injury	:	
8.	Time & Date of Injury	:	
9.	Time of Arrival to Hospital	:	
10.	Any Associated Injury	:	
11.	Vascular Complications	:	Yes / No
12.	Compartmental Syndrome	:	Yes / No
13.	Seinsheimer Classification of Fracture	:	
14.	Initial Management given	:	
15.	Preoperative Antibiotics used	:	
16.	Preoperative Transfusion	:	

17.	Time between arrival & Surgery	:		
18.	Date of Surgery	:		
19.	Type of Anesthesia	:		
20.	Surgical Procedure	:		
21.	Difficulty during surgery	:		
22.	Blood loss during surgery	:		
23.	Duration of surgery	:		
24.	Post operative transfusion	:		
25.	DT Removed on	:		
26.	SR Done on	:		
27.	Mobilization started on	:		
28.	Post operative complications	:	a.	Embolism
			b.	Respiratory
			c.	Infection
			d.	Nerve injury
			e.	Vascular
29.	Limb length equality achieved	:	Yes / No	
30.	Partial Wt bearing started on	:		
31.	Full Wt. Bearing started on	:		

Follow-up :

Date	Pain	Walking	Function	Motion muscle power	Daily activities	Shortening	Radiological evaluation	Results

SEINSHEIMER CLASSIFICATION



MASTER CHART

S. No	Name	Age	Sex	Mode of Injury	Involved Side	Asso. Inj	Classification Seinsheimer	Interval bet inj & surgery	Mode of treatment	Follow up period (mths)	Clinical examination during last follow-up								Complications	Result
											Pain	Walking	Function	Muscle power	Daily activities	Short-ening	x-ray evaluation	Total		
1	Sekar	56	M	Fall	Right	-	II B	5	PFN	22	8	10	8	8	9	10	10	63		Good
2	Saravanan	36	M	RTA	Left	-	III A	3	PFN	19	8	10	10	10	10	10	10	68		Excellent
3	Kanniyappan	45	M	Fall	Left	# Shaft of humerus	IV	4	PFN	20	8	10	10	8	10	10	10	66		Excellent
4	Kuppan	52	M	RTA	Left	Colle's #	III B	6	PFN	18	6	6	6	6	5	6	6	41	Malunion	Poor
5	Ramalingam	40	M	Fall	Left	-	III A	7	DCS	8	8	10	8	8	9	10	10	63		Good
6	Narasimman	65	M	Fall	Left	-	IV	10	DHS	12	6	8	8	8	7	8	8	53		Good
7	Fazil	40	M	RTA	Right	-	V	6	Recon Nail	6	6	6	6	6	5	6	6	41	Delayed healing	Poor
8	Shanmugham	51	M	Fall	Left	-	II B	5	DCS	18	10	10	10	8	10	10	10	68		Excellent
9	Malarkodi	42	F	RTA	Left	-	III A	5	95° ABP	14	6	4	4	6	3	4	6	33	Implant failure	Failure
10	Madavan	25	M	RTA	Right	# BB FA	IV	5	DCS	9	6	6	4	6	7	6	4	39	Malunion	Poor
11	Maragatham	38	F	RTA	Left	-	II A	5	DCS	12	8	8	8	8	9	8	8	57		Good
12	Vadivelu	35	M	RTA	Right	Head Injury	V	15	DHS	24	6	8	8	8	9	8	8	55		Good
13	Pandian	55	M	Fall	Right	-	II A	3	DCS	17	8	10	10	10	10	10	10	68		Excellent
14	Ramasamy	61	M	Fall	Right	-	IV	7	DHS	20	6	8	6	6	7	8	8	49	Wound healing	Good
15	Pitchandi	53	M	Fall	Right	-	III B	7	DCS	14	8	8	8	8	9	10	10	61		Good
16	Ganapathy	36	M	RTA	Right	# 5th MT	III A	8	PFN	16	8	10	10	10	10	10	10	68		Excellent
17	Seetha	51	F	Fall	Right	-	II B	11	DCS	18	8	8	8	8	9	8	8	57		Good
18	Suriya	35	M	RTA	Left	-	V	3	PFN	15	10	10	10	8	10	10	10	68		Excellent
19	Ajith	22	M	RTA	Right	Head Injury	V	12	PFN	14	8	8	8	8	7	8	8	55		Good
20	Latha	52	F	Fall	Right	-	III A	5	Recon Nail	18	8	10	10	8	9	10	10	65		Excellent

RTA - Road Traffic Accident

BB FA - Both Bones Forearm

PFN - Proximal Femoral Nail

Recon Nail - Reconstruction Nail

DCS - Dynamic Condylar Screw

DHS - Dynamic Condylar Screw

ABP - Angled Blade Plate

MT - Metatarsal